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The Evolving Law and Regulation of the Carriage of Dangerous Goods by Sea – the IMDG Code and the IMSBC Code

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Abstract. *The current article is practice-oriented and is intended for shipowners and sea carriers as well as for practitioners and students who wish to revise or expand their knowledge on this specific area of the carriage of goods by sea. The paper provides the reader with a thorough understanding of the main instrument regulating the carriage of dangerous cargo – the IMDG Code. Further, Section II of the paper addresses also the carriage of solid bulk cargo (the IMSBC Code) and the most frequent problems and hazards which are associated with the transportation of such cargo. In general, the paper analyses the process of carriage of hazardous cargo from the perspective of the carrier, and, thus, it may be used as a guide to the carriage of dangerous goods.*

I. The IMDG Code

1. Introduction

The International Maritime Dangerous Goods (IMDG) Code², written under the auspices of the International Maritime Organization (IMO), is a uniform international code for the transport of dangerous goods and marine pollutants by sea. It aims at enhancing “*the safe carriage of dangerous goods while facilitating the free unrestricted movement of such goods and preventing pollution to the environment*”.³ The Code lists and describes the dangerous goods that may be carried by sea, and contains mandatory instructions on terminology, packaging, labelling, placarding, markings, stowage, segregation, ventilation, handling, training of shore-based personnel, and emergency response. It contains detailed technical specification of any cargo that is considered dangerous due to its flammable, corrosive, toxic, poisonous or other hazardous nature and properties. The Code consists of two volumes, and it classifies dangerous goods into nine classes according to the hazard they present during transportation: explosives (*Class 1*), gases (*Class 2*), flammable liquids (*Class 3*), flammable

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² The Code and its bi-annual amendments are published by the International Maritime Organization (IMO) in two volumes, which can be ordered at: <http://www.thecompliancecenter.com/publications/imdg.htm>. Additional support can be found at <http://www.imo.org/Publications/IMDGCode/Pages/Default.aspx> and <http://www.imdgsupport.com>.

³ The IMDG Code, Preamble, para 1.

solids (*Class 4*), oxidizing substances (*Class 5*), toxic and infectious substances (*Class 6*), radioactive material (*Class 7*), corrosive substances (*Class 8*), and miscellaneous dangerous substances and articles (*Class 9*).

The IMDG Code supplements the principles laid down in the SOLAS Convention (addressing safety of life sea) and the MARPOL Convention (covering prevention of pollution from ships). The Code has been changed and updated every two years in order to keep pace with the developments in the shipping industry. The Code's latest edition is IMDG Code 2014, known as Amendment 36-12, and it is valid until December 31, 2015. Each amendment of the Code is valid for three years as the year preceding an amendment, and the one following an amendment, are considered transition years, in which both the old edition of the Code and the new one can be used. For example, the *IMDG Code 2012* (Amendment 35-10) was issued on January 1, 2011 and it applied until December 31, 2013. Similarly, the *IMDG Code 2014* was issued on January 1, 2013, and it applies until December 31, 2015. Therefore, in the year of 2013, which is a transition year, both versions of the Code could have been used. However, in the year, which the respective edition of the Code signifies, only that particular Amendment is applicable (*i.e.* in 2014, only the *IMDG Code 2014* could be used).

The IMDG Code is applicable to all ships which are flying the flag of a contracting party to SOLAS 1974⁴, and which are carrying dangerous goods (defined as “*the substances, materials and articles covered by the IMDG Code*”). After 1 January 2004, the Code became mandatory for adoption by all SOLAS signatory states. Thus, except for a few provisions that are still recommendatory, the IMDG Code is a mandatory instrument by force of Chapter VII of SOLAS 1974 and Annex III of MARPOL 73/78.

2. Documents needed for the transportation of dangerous goods

A carrier shall not accept dangerous goods for transport unless a copy of the dangerous goods transport document is provided by the shipper. This document may consist of more than one page and it can be a bill of lading, a shipping order, a waybill or in any other form, paper or electronic, provided that it contains all the relevant safety information required by the *IMDG Code*. This information shall include the hazardous cargo's UN Number, the Proper Shipping Name (PSN) and supplementary description, the primary and subsidiary hazard class or division number, and the packing group (where assigned) for that particular substance. The dangerous goods transport document shall also embody a declaration or certificate, signed and dated by the shipper, stating that the consignment is acceptable for transport and the goods are properly packaged, marked, and labelled. The shipper and the carrier shall retain a copy of the dangerous goods transport document, and also of any additional information and documentation, for a minimum of three months.

Also, a ship, carrying dangerous goods, shall have a special list, a cargo manifest or a stowage plan, specifying the particular dangerous goods carried on board as well as their total quantity and location aboard the vessel. In certain circumstances, special certificates or other

⁴ The International Convention for the Safety of Life at Sea (SOLAS), 1974, Chapter I, Article II. A complete list with all contracting parties can be found at <https://imo.amsa.gov.au/public/parties/solas74.html> and at IMO's status of conventions: <http://www.imo.org/About/Conventions/StatusOfConventions/Documents/status-x.xls>.

documents are required such as: a weathering certificate; a container/vehicle packing certificate; a certificate exempting a substance from the *IMDG Code*; and, with regard to new self-reactive substances and organic peroxides, a statement by the competent authority of the country of origin of the approved classification and conditions of transport.

3. Identification of the dangerous goods

The information, indicating the cargo's characteristics and risks, is to be found on the cargo's markings, labels, and in the abovementioned documentation. The *IMDG Code* requires that all packages and drums, carrying dangerous goods, must have labels which show the symbol of the class of the goods and the class number.⁵ Each label is divided into two parts: the top half shows the symbol of the class of the goods, while the bottom part contains the text and class number (*see Fig 1*). In the case of marine pollutants, the words MARINE POLLUTANT must be on the transport document and the respective label shall be placed on the package (*see Fig 2*).⁶

Cargo transport units, such as containers, trailers, portable tanks, railway wagons, carrying packaged or unpackaged dangerous goods, shall also be marked with placards, showing the United Nations Number and the Proper Shipping Name of the hazardous cargo (*see Fig 3*). Cargo transport units, containing substances in a liquid state at a temperature equal to or exceeding 100°C, or in a solid state at a temperature equal to or exceeding 240°C, shall bear the mark indicated in *Fig 4*.



Fig 1: Class 4.3
Combustible solids
when in contact
with water



Fig 2:
Marine
Pollutant
mark



Fig 3: * location
of class
** location of
UN Number



Fig 4: Mark
for transport
at elevated
temperature

In addition to that, all cargo transport units (*e.g.* containers, trailers, portable tanks), carrying packaged or unpackaged dangerous goods, shall also be marked with placards, showing the class, the United Nations (UN) Number, and the Proper Shipping Name (PSN) of the dangerous goods. While the UN Number⁷ is a four-digit number that uniquely identifies a hazardous substance, the PSN represents its corresponding name. These two enable the carrier to rapidly and precisely identify a substance so that proper handling is ensured and also that the correct procedures are followed in the event of an emergency. Knowing the UN Number of a substance, the carrier may then consult the *Dangerous Goods List* (DGL) in the *IMDG Code Chapter 3.2*, where all relevant information can be obtained in the form of a table containing specific entries of any dangerous good. Each individual entry is divided into 18 columns that specify various characteristics of the substance such as: the UN Number (*Column 1*), the PSN (*Col 2*), Class (*Col 3*), Subsidiary risk(s) (*Col 4*), Packing group (*Col 5*), Stowage and Segregation (*Col 16*), Properties and observations (*Col 17*), *etc.* To look up an entry, a carrier only needs to locate the respective UN Number.

⁵ To determine which class of substances is indicated by a label, check the specimen labels, which can be found in the *IMDG Code paragraph 5.2.2.2.2*.

⁶ In this case, the captain of the vessel must comply with the requirements of *Annex III of MARPOL 73/78*.

⁷ All dangerous goods are assigned a UN Number as the numbers range from UN0001 to UN3506.

4. Transport operations

Dangerous goods usually present risks in maritime transport that emanate from the packaging, stowage, segregation, and separation.

Firstly, the type of packaging frequently has a decisive effect on the hazard. Packages/containers must be safe, strong enough to endure rain, wind and sea water, correctly marked, and they must not be affected by the cargo that they contain. Most of the dangerous goods are divided into three packing groups (see *DGL, Column 5*), indicating the degree of danger. These are Packing Group I, II, and III, which signify a high, a medium, and a low level of danger, respectively.

Secondly, the *IMDG Code* requires dangerous goods to be stored and segregated according to their class, compatibility, and the hazard they present. There are 5 general stowage categories: A, B, E (*on deck/below deck*), C, D (*on deck only*).⁸

Thirdly, the segregation tables in *Section 7.2.4* (general segregation provisions) and *Section 7.6.3.5.2* (segregation on general cargo ships) show the required segregation between two or more substances which are mutually incompatible. The segregation is indicated with one of the following terms: “*Away from*” (3 meters of separation, which is the minimum level of separation); “*Separated from*” (6 meters of separation); “*Separated by a complete compartment or hold from*” (12 meters of separation); “*Separated longitudinally by an intervening complete compartment or hold from*” (24 meters of separation, which is the maximum level of separation). When the aforementioned two tables are silent, the *DGL* in *Column 16* should be consulted. Furthermore, masters must be aware that even dangerous goods that belong to the same class may have segregation requirements (e.g. *Class 8*, alkalis and acids), and this is indicated only in the *DGL*.

Before opening the doors of the cargo transport units upon unloading, crews should consider the possibility of unsafe conditions such as leakages, contamination or depleted oxygen. Moreover, whatever dangerous goods are carried on board, smoking shall be strictly prohibited other than in the designated smoking areas. Appropriate signs shall be displayed at the gangway and on deck. Similarly, any time when special works are carried out on board, such as welding, the location and properties of the dangerous goods shall be considered. In the event of an incident with dangerous goods, detailed recommendations are contained in *The EmS Guide: Emergency Response Procedures for Ships Carrying Dangerous Goods*, which is a supplement to the *IMDG Code*. In any event, masters should bear in mind that the safety of the crew has priority over any considerations with regard to prevention of pollution of the sea.

5. Is the vessel cargoworthy for the carriage of dangerous goods?

Ships which are intended to carry dangerous goods or solid bulk cargo (see *Section II* on the *IMSBC Code*) are required to have a valid *Document of Compliance with the Special Requirements for Ships Carrying Dangerous Goods* or a *Document of Compliance when Carrying Dangerous Goods in Solid Form in Bulk*, respectively. This document is issued by a

⁸ For *Class 1* substances, there are separate stowage categories: 01, 02, 03 (*on deck in closed cargo transport unit, or below deck*), 04 (*on deck/below deck in closed cargo transport unit*), and 05 (*on deck only in closed cargo transport unit*).

competent authority following a satisfactory survey of the ship.⁹ The document certifies the classes of dangerous goods that are allowable to be carried on board the vessel and also shows the allowed locations for stowage for each class. When a request for carriage of dangerous goods is sent by a shipper, the application shall be rejected if any safety information submitted by the shipper is incorrect or if the hazardous cargo is not acceptable according to the ship's Document of Compliance. It is noteworthy that all documents related to the carriage of hazardous cargo are strictly scrutinized by port officials, and any irregularities in such documentation may result in fines or detention of the vessel.

The Document of Compliance is, however, not required for the carriage of infectious substances (*Class 6.2*) and radioactive material (*Class 7*).

When infectious substances are offered for transport, the *IMDG Code* requires that the full address of the consignee shall be stated on the transport document, together with the name of a responsible person and his or her telephone number. These substances contain a pathogen that causes disease in humans or animals and their transportation is further regulated by the World Health Organization's (WHO) *Guidance on regulations for the Transport of Infectious Substances*.

With regard to the carriage of *Class 7* substances, the carrier shall make sure that all the additional information required by *IMDG Code paragraph 5.4.1.5.7.1* is included in the transport document. The principal regulation for such carriage is the *Regulations for the Safe Transport of Radioactive Material* issued by the International Atomic Energy Agency (IAEA), which aims at protecting people and the environment from the effect of radiation. A fundamental principle is that safety is ensured first and foremost by the design of the package rather than by how the material is transported. The *IAEA Regulations* are further complemented by IMO's *International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code)*, which covers ship design, construction and equipment as well as areas such as damage stability, fire and radiological protection, and temperature control of cargo spaces.

II. The IMSBC Code

1. Dangerous goods in bulk

The *IMDG Code* is supported by a variety of international conventions, codes, and recommendations, one of which is the *International Maritime Solid Bulk Cargoes (IMSBC) Code*, which is also mandatory. The main points of this Code and the major problems that it strives to prevent will be laid down in this section.

Before accepting bulk cargo for shipment, a carrier must be aware of the following general procedures. First and foremost, the shipper/charterer must provide information about the cargo's Bulk Cargo Shipping Name (BCSN), its UN Number (if the cargo is also a dangerous good), total quantity, stowage factor, physical and chemical properties, and a

⁹ *SOLAS Reg. II-2/19.4.*

declaration that the provided information is correct. Secondly, the carrier must consult the *IMBSC Code Appendix 1*, which contains and lists individual cargoes and their properties as well as instructions on stowage, segregation, loading, handling, likely hazards, precautions, hold cleanliness, ventilation, carriage, and discharge.¹⁰ Thirdly, masters should be aware that solid bulk cargoes have to be properly distributed throughout the ship for adequate stability and for preventing overstressed ship's structure.

2. Particular hazards handled by the IMSBC Code

The *IMSBC Code* distinguishes between three groups of solid bulk cargoes.

Group A consists of cargoes that may liquefy, which may lead to shifting of cargo, reduced ship stability, and even capsizing. Liquefaction occurs due to energy being applied to the cargo as a result of vibration caused by the ship's engine or by the motion in heavy seas, meaning that the process may appear at any stage of the voyage. Cargoes that are prone to liquefaction contain certain amount of moisture and small particles: *e.g.* mineral ore concentrates (copper, iron, lead, nickel, or zinc concentrate); nickel ore; and also coal (bituminous and anthracite), being normally a Group B substance that can also be classified as both Group A&B, when 75% of the cargo is made up of particles less than 5 mm in size.

To monitor and control the risks, Group A cargoes shall be tested by the shipper before loading in order to determine their Transportable Moisture Limit (TML) as well as their actual moisture content before they are shipped.¹¹ The results of these tests must be provided by the shipper to the master, together with signed certificates, and, in case the actual moisture content is higher than the TML, the cargo should not be accepted for carriage. In any case, the master should consider the following additional safety measures: visual monitoring during loading and looking for indications of high moisture; trimming the cargo to prevent shifting; preventing water from entering the cargo space.

A particular risk is hidden in loading cargo at sub-zero temperature, because it may contain ice crystals even if it appears not to be damp. In that case, it is recommended that samples should be drawn from various levels, and then warmed up and tested.

Furthermore, it is important to note that if, during transportation, a cargo of a finely-divided material starts to flatten and develops a water-containing or putty-like surface, then this means that it has started to liquefy. Should this happen, the ship must proceed to the nearest port. Speed and course may have to be adjusted to reduce the motion of the vessel.

Group B consists of materials possessing chemical hazards, which may cause fire, explosion, corrosion, or release of toxic gas when transported in bulk. Some of them are classified as dangerous goods, and thus are to be found in the *IMDG Code*, while others are

¹⁰ If the substance is not listed in *Appendix 1 (Individual Schedules of Solid Bulk Cargoes)*, the shipper must provide details about the cargo to the competent authorities of the port of loading. Advice is to be sought also from the competent authorities of the port of unloading and of the flag state. Based on that information, the three competent authorities will assess the acceptability for shipment and give the master a certificate stating the characteristics of the cargo and the conditions for carriage and handling. See the *IMBSC Code* Section 1.3.

¹¹ The TML is the maximum moisture content that is safe for carriage. TML tests shall be conducted within six months prior to loading, whereas tests for actual moisture contents shall be conducted no more than seven days prior to loading (*IMSBC Code* section 4.5).

classified in the *IMBSC Appendix 1* under Materials hazardous only in bulk (MHB). Many Group B substances are incompatible and, in order to prevent potential hazards, carriers must follow the provisions of the *IMBSC Code section 9.3* on stowage and segregation. Examples of Group B cargoes are: coal, which can heat up spontaneously, deplete oxygen and corrode metal structures; direct reduced iron (DRI), which may react with water and air to produce hydrogen and heat; metal sulphide concentrates, which are prone to oxidation and self-heating; wood products such as logs, pulpwood, and timber, which may deplete oxygen and increase the carbon dioxide in the cargo space. Some of the common measures to mitigate the risks include natural or mechanical ventilation and, in some cases, explosion-proof ventilation; gas-monitoring detectors, and applying a coating to the cargo space structure before loading.

The carriage of direct reduced iron (DRI) requires special attention. The term is generic and covers a number of products, which have various properties and hazards. In general, the DRI normally appears in the form of sponge pellets or lumps with a diameter of 6 to 25 mm. Three types of DRI are distinguished: DRI(A), which is less reactive and has high density, known also as Hot Briquetted Iron (HBI); DRI(B), which is highly reactive and has high density, and is in the form of lumps and pellets; and DRI(C), which includes all the substances generated as by-products in the manufacture process of the former two types. In general, if any DRI becomes wet, this substance can considerably overheat and emit hydrogen gas, while oxygen in enclosed spaces may be depleted. That is why it must be carried under inert conditions, meaning that nitrogen gas shall be used and applied to the holds prior to loading as an inert-gas blanket. Also, thermocouples must be positioned throughout the cargo at different heights in order to monitor the temperature. Hydrogen and oxygen gas-monitoring in the holds should also be undertaken throughout the voyage. Finally, DRI products must be kept dry at all times before and throughout the voyage, and loading conveyors shall also be kept dry.

Group C consists of cargoes which carry risks different to the hazards associated with groups A and B, which means that they neither liquefy, nor possess chemical hazards. Such cargoes are: iron ore and high-density cargoes, which can overstress the tanktop; cement, which may shift during loading and damage ship structures; sand and fine particles, which may be inhaled and cause respiratory disease. To minimize those risks, carriers must consider applying appropriate safety measures and precautions. Those include trimming and evenly distributing the cargo both at loading and during the voyage; careful ballasting operations and loading sequence, especially when high-density cargoes are loaded such as iron ore; as well as preventing cargo from going into the bilge wells. Machinery and accommodation spaces may have to be protected, too, from Group C substances such as dust of sand and cargo of fine particles. If members of the crew are to be exposed to such cargoes, they should be equipped with goggles, dust masks and protective clothing.

III. Conclusion

It is important to underline that in practice a lot of shippers, charterers or forwarders do not provide the full information about the hazardous cargo, or else abuse the shipping data

on the documents upon requesting the shipment of such cargo. That is why the vessel operators must be completely satisfied with the accuracy and completeness of the information about the dangerous cargo and always insist on a full product description, even if that requires some further back-and-forth communication. It is very important for carriers never to willfully take custody and load cargo when its contents is unclear. The sinking of *Kapitan Sakharov* (1993) due to undeclared hazardous cargo in deck containers, and the total loss of *Thor Emilie* (2000), which carried misdeclared cargo, as well as of *The Ythan* (2004), which sank due to an explosion of DRI cargo that was misleadingly described, are all sheer examples of the gravity of improper documentation and unawareness of the potential hazards. Besides the loss of profits, the loss of the vessel, and the environmental degradation, we are dealing here also with possible loss of human life that could result from misdeclared hazardous cargo, improper documentation and/or underestimating safety measures for carrying dangerous goods.